Docket Number
90606.80/ok

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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| Appellant: Takaharu SUZUKI et al.<br><br>Application No.: 10/564,425<br><br>Confirmation No.: 8036<br><br>Filing or 371(c) Date: January 11, 2006<br><br>Title: TITANIUM ALLOY PART AND METHOD FOR PRODUCING THE SAME | Art Unit: 1793<br><br>Examiner: M. Shevin |

**APPEAL BRIEF UNDER 35 U.S.C. § 134(a)**

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is an Appeal pursuant to 35 U.S.C. § 134(a) from the Examiner's rejection of Claims 18 and 20-26 in the outstanding Office Action dated July 28, 2008.

**REAL PARTY IN INTEREST:**

The real party of interest is the assignee, Yamaha Hatsudoki Kabushiki Kaisha, 2500 Shingai, Iwata-shi, Shizuoka-ken, JAPAN 438-8501.

**RELATED APPEALS AND INTERFERENCES:**

Appellant, assignee, and the undersigned attorney of record are not aware of any prior or pending appeals, judicial proceedings or interferences which may be related to, directly affect or be directly affected by or having a bearing on the Board's decision in the pending Appeal.

**STATUS OF CLAIMS:**

Claims 18 and 20-26 are pending.

Claims 18 and 20-26 are rejected and are the subject of this appeal.

**STATUS OF AMENDMENTS:**

No amendments were filed subsequent to the Final Rejection dated July 28, 2008.

**SUMMARY OF CLAIMED SUBJECT MATTER:**

Claim 18

A titanium alloy part having a compressive stress of approximately 270 MPa or more within a depth of about 100 μm from a surface thereof [page 10, lines 20-22 of Appellant's Substitute Specification]; wherein

a surface region extends from the surface to a depth of about 100 μm, and an internal region is disposed internally relative to the surface region [page 10, lines 17-22]; and

the surface region includes a modified layer containing more α phase than does the internal region [page 15, lines 1-5 and Fig. 5A], the modified layer accounting for a proportion of about 10 vol% or less of the surface region [page 13, lines 10-15].

**GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL:**

1. The Examiner's rejection of Claims 18 and 20-26 under 35 U.S.C. § 103(a) as being unpatentable over Lutjering et al. ("Titanium").

**ARGUMENT:**

Claim 18 recites:

> **A titanium alloy part having a compressive stress of approximately 270 MPa or more within a depth of about 100 μm from a surface** thereof; wherein
>
> a surface region extends from the surface to a depth of about 100 μm, and an internal region is disposed internally relative to the surface region; and
>
> **the surface region includes a modified layer containing more α phase than does the internal region, the modified layer accounting for a proportion of about 10 vol% or less of the surface region**. (emphasis added)

The Examiner alleged that it would have been obvious to one of ordinary skill in the art, in view of the disclosure of Lutjering et al., to shot peen a titanium alloy part to produce a compressive stress of at least 270 Mpa or more with a depth of about 100 μm "and to polish, chemically mill, or remove surface material to reduce the vol% of a modified surface layer to 10 vol% or below in view of Lutjering's teaching regarding surface damage, cracks, and nicks."

Alternatively, the Examiner alleged that it would have been obvious to one of ordinary skill in the art "to choose the instantly claimed ranges through process optimization, since it has been held that [w]here the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art," (see, for example, the paragraph bridging pages 3 and 4 of the Office Action dated July 28, 2008).

In particular, the Examiner alleged that surface damage such as nicks, scratches, gouges, or abusive machining in the surface of a titanium part create the risk of unforeseen fatigue failure and that "presumably one of ordinary skill in the art would reasonably remove these layers by polishing, chemical milling, or any other appropriate surface removal/smoothing technique to yield a smooth surface free of crack initiation sites," (see the first full paragraph on page 3 of the Office Action dated July 28, 2008).

In section 3.7.1 on page 114 of Lutjering et al., upon which the Examiner relied to

support the allegation that it would have been obvious to remove damaged surface layers, Lutjering et al. teaches:

> Inadvertent introduction of surface damage (nicks, scratches, gouges or abusive machining) can affect the conversatism of these curves creating unforeseen risk of fatigue failure. **The beneficial effects of shot peening more than compensate for the presence of surface damage** and, therefore, can be thought as introducing a "safety net" with respect to fatigue, **provided the damage is not too severe or too deeply embedded**. (emphasis added)

As seen from the above teaching of Lutjering et al., shot peening more than compensates for the presence of surface damage such that one of ordinary skill in would readily understand that the presence of surface damage after shot peening is acceptable to a certain degree. Although Lutjering et al. cautions that the surface damage should not be "too severe or too deeply embedded," there is no teaching or suggestion in Lutjering et al. that polishing or chemical milling, such as that disclosed in section 3.7.3 of Lutjering et al., could or should be performed *after* shot peening to remove severe or deeply embedded surface damage. The Examiner has not provided any evidence that one of ordinary skill in the art would employ polishing or chemical milling to remove *severe or deeply embedded* surface damage after shot peening. Moreover, the Examiner has not provided any evidence that polishing or chemical milling could remove the severe or deeply embedded surface damage contemplated by Lutjering et al.

The Examiner further alleged that "Lutjering et al. also teaches that chemical milling is used to remove contaminated material from the surface of titanium parts, such as oxide layers," (see the second full paragraph on page 3 of the Office Action dated July 28, 2008). The Examiner also alleged that although Lutjering et al. teaches that chemically milled surfaces are often shot peened to create or restore surface residual stress, "this teaching operates on the assumption that peening will not introduce this same class of defects," (see, again, the second full paragraph on page 3 of the Office Action dated July 28, 2008).

Appellant respectfully disagrees for the following reasons.

First, as acknowledged by the Examiner in the second full paragraph on page 3 and the second full paragraph on page 6 of the Office Action dated July 28, 2008, Lutjering et al. teaches that chemical milling is a process used to remove material that has become contaminated "for example, by oxygen, during processing" (see, for example, the first full paragraph on page 114 of Lutjering et al.). In section 3.7.3 on pages 121-122, Lutjering et al. teaches that chemical milling is a common way to selectively remove material from the surface of a component "to create an array of features," e.g., a waffle pattern to impart stiffness. Nowhere in the disclosure of Lutjering et al. does Lutjering et al. teach or suggest that chemical milling should be performed after shot peening to reduce surface damage.

Second, on the one hand, if the shot peening does not introduce the same class of surface defects or damage alleged by the Examiner, one of ordinary skill in the art would not subsequently chemically mill the shot peened surface since there is no surface damage that should be removed. In this circumstance, the modified layer containing more α phase of the titanium due to the shot peening would extend much farther into the surface region of the titanium and clearly does not account for a proportion of about 10 vol% or less of the surface region, as recited in Appellant's claim 18.

On the other hand, if the shot peening does introduce the same class of surface defects or damage alleged by the Examiner, and assuming *arguendo* that one of ordinary skill in the art would subsequently chemically mill the shot peened surface, Lutjering et al. clearly teaches that the chemically milled surface should be shot peened to restore the surface residual compressive stress (see, for example, the last sentence in the first full paragraph on page 114 of Lutjering et al.). According to the Examiner, chemical milling should be performed whenever the shot peening introduces surface defects or damage, and shot peening should be last the step in the process only if no surface defects or damage are introduced during this shot peening step.

Thus, in view of the above allegations by the Examiner and the emphasis by Lutjering et al. that shot peening should be performed after chemical milling to create or restore the surface residual compressive stress, any step of chemical milling should always be followed by a step of shot peening until the shot peening does not introduce any surface defects or damage. Thus, the last step will ALWAYS be shot peening in which the modified layer, which contains more α phase of the titanium due to the shot peening, extends much farther into the surface region of the titanium and clearly does not account for a proportion of about 10 vol% or less of the surface region, as recited in Appellant's claim 18.

In the Advisory Action dated November 5, 2008, the Examiner alleged that "through the proper selection of peening parameters [the] alpha phase would not be formed during peening." The Examiner further alleged that "a two-tiered peening approach is within the purview of Lutjering where a first intense peening step designed to impart residual compressive stress deep within the target titanium part leaves a cracked surface which is then removed by polishing or milling" and to reapply the residual compressive stress, "a very light peening process designed to not introduce 'deep scratches' or 'heavily damage' the surface is applied."

Appellant respectfully disagrees with the Examiner's allegations for the following reasons.

First, the Examiner's allegation that the alpha phase would not be formed if the shot peening parameters are properly selected is incorrect. It is a well known fact that shot peening inherently creates an alpha phase in the surface of the titanium (see, for example, paragraph [0045] of Appellant's Substitute Specification). Furthermore, assuming *arguendo* that it is somehow possible to select shot peening parameters such that an alpha phase is not created, which as noted above is directly contrary to what is well known to those of ordinary skill in the art, the Examiner has not established or provided any support for his conclusion that the recited compressive stress of "approximately 270 MPa or more within a depth of about 100 μm from a surface" would

be created in the titanium alloy part by a "very light" peening process.

Second, Lutjering et al. does not teach or suggest a two-tiered peening approach, let alone that the second peening step should be "very light" so as not to create an alpha phase when reapplying the residual compressive stress. Nowhere does Lutjering et al. teach or suggest a "very light" shot peening, whatever that may be, and the Examiner has not shown by any objective evidence that a "very light" shot peening would still result in a modified layer containing more α phase than does the internal region wherein the modified layer accounts for a proportion of about 10 vol% or less of the surface region.

Thus, Lutjering et al. clearly fails to teach or suggest the features of "A titanium alloy part having a compressive stress of approximately 270 MPa or more within a depth of about 100 μm from a surface thereof" and "the surface region includes a modified layer containing more α phase than does the internal region, the modified layer accounting for a proportion of about 10 vol% or less of the surface region," as recited in Appellant's claim 18.

Accordingly, Appellant respectfully submits that the rejection of claim 18 under 35 U.S.C. § 103(a) as being unpatentable over Lutjering et al. should be reversed, and claims 18 and 20-26 are allowable.

Respectfully submitted,

Dated: January 23, 2009

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**CLAIMS APPENDIX:**

Claims 1-17 (canceled).

Claim 18 (previously presented): A titanium alloy part having a compressive stress of approximately 270 MPa or more within a depth of about 100 μm from a surface thereof; wherein

a surface region extends from the surface to a depth of about 100 μm, and an internal region is disposed internally relative to the surface region; and

the surface region includes a modified layer containing more α phase than does the internal region, the modified layer accounting for a proportion of about 10 vol% or less of the surface region.

Claim 19 (canceled).

Claim 20 (previously presented): The titanium alloy part of claim 18, wherein the surface has a maximum surface roughness Rt of about 20 μm or less.

Claim 21 (previously presented): The titanium alloy part of claim 18, wherein the titanium alloy part contains about 50 vol% or more of β phase at room temperature.

Claim 22 (previously presented): The titanium alloy part of claim 18, wherein the titanium alloy part is a spring.

Claim 23 (previously presented): The titanium alloy part of claim 18, wherein the titanium alloy part is a suspension spring for a vehicle.

Claim 24 (previously presented): The titanium alloy part of claim 18, wherein the titanium alloy part is one selected from the group consisting of a valve spring for an

engine, a connecting rod for an engine, and a structural part for an aircraft.

Claim 25 (previously presented): An engine comprising the titanium alloy part of claim 18.

Claim 26 (previously presented): A vehicle comprising the titanium alloy part of claim 18.

Claims 27-34 (canceled).

**EVIDENCE APPENDIX:**

None.

**RELATED PROCEEDINGS APPENDIX:**

None.